Findings and Recommendations

"Japan-Russia-United States Study Group on Dumped Nuclear Waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean"

Biloxi, Mississippi; January 12-13, 1995

PROJECT BACKGROUND

Although the former Soviet Union had long been suspected of dumping radioactive and other hazardous wastes in surrounding coastal waters, Washington and Tokyo did not become aware of the scope of the problem until 1991. Russian environmentalists and nuclear scientists revealed that not only had a number of nuclear accidents gone unreported, but also that toxic and nuclear waste had been discharged into the sea. An estimated 18 nuclear reactors, some still containing fuel, had been dumped at sea—some within the holds of nuclear submarines—and more than 2.5 million curies of radioactive wastes were also discharged into the ocean. These figures, compiled by Dr. Aleksei V. Yablokov, former environmental advisor to Russian President Boris Yeltsin, now Environmental Advisor of the Russian National Security Council, are double what was previously believed to have been dumped at sea globally during the Cold War. Since some of this waste was dumped into the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean, Tokyo called for an immediate halt to all dumping at sea. Russia's Minister for Environment, Viktor Danilov-Danilyan, promised that the Navy would temporarily stop dumping waste, but stressed that lack of proper disposal sites and technologies might force Russia to resume dumping at sea. According to Danilov-Danilyan, funding and technological support—especially Japanese and American—were absolutely crucial to the appropriate disposal of Russian radioactive and toxic waste. In subsequent Russo-Japanese meetings, the Clinton-Yeltsin summit, and Gore-Chernomyrdin discussions, Russian representatives repetitively cited lack of adequate waste storage facilities, funding, and technology as stumbling blocks to solving the waste disposal disaster. As a result, the U.S. and Japanese governments are currently engaged in a joint effort to alleviate the dumping problem, as outlined in the *Common Agenda for Cooperation in Global Perspective*—an agreement reached at the Clinton-Hosokowa summit last year.

In order to better understand this nuclear waste disposal conflict, and to find innovative methods for alleviating the situation, the Center for International Security and Strategic Studies at Mississippi State University, in conjunction with the United States Geological Survey of the Department of Interior and the Center for United States-Japan Studies and Cooperation at Vanderbilt University, formed the *"Japan-Russia-United States Study Group on Dumped Nuclear Waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean."* This Study Group's

purpose was to provide a neutral forum in which participants could freely exchange views and open new channels of communication. Its focus was two-fold: (1) the collection and compilation of data, as well as evaluation of the present conditions of existing dumping sites in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean; (2) the discussion and identification of alternative disposal methods for radioactive wastes agreeable to all parties. The areas of risk assessment, data collection, site analysis, public health, and disposal alternatives were also thoroughly explored by all panelists in a round-table format—a proven strategy which provided spirited discussions and frank exchange of viewpoints and ideas.

Obviously, trilateral cooperation was necessary to develop a satisfactory program for dealing with this waste disposal problem. Waste discharged into those seas which lie between Russia and Japan may be swept toward Alaska, and scientists are currently concerned about the possibility that radionuclides may be transported through air masses. The dumped nuclear waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean may affect the public health and safety of Japan, Russia, and the United States. Therefore, our purpose in establishing this study group was dual in nature: (1) to promote the open discussion and information exchange necessary to understand the risks and scope of this critically important issue, and (2) to synthesize all aspects of the dumping question within the framework of the Common Agenda for Cooperation in Global Perspective, the Gore-Chernomyrdin Committee's activities, and bilateral Russo-Japanese cooperation.

FRAMEWORK

The CISS has joined forces with the Center for U.S.-Japan Studies and Cooperation, Vanderbilt University's Institute for Public Policy Studies, and the U.S. Geological Survey. The three institutions' respective representatives, Directors Dr. Janos Radvanyi and Dr. James Auer, as well as Chief of International Environmental Studies Dr. Bruce Molnia, established a Preparatory Committee in order to finalize workshop details such as a workshop agenda and a list of participants. This committee first focused on evaluating the present condition of dump sites and identifying any significant environmental damage or risks, carefully considering necessary information in order to conduct a successful workshop.

On January 12 and 13, 1995, our workshop, "The Japan-Russia-United States Study Group on Dumped Nuclear Waste in the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean" was held at Biloxi, on the Mississippi Gulf Coast. This ground-breaking meeting created a foundation for a highly productive Japan-Russia-United States dialogue which in turn established a basis for cooperation among these three nations in order to develop a satisfactory program for dealing with nuclear waste disposal problems. This foundation allowed representatives of these three nations, along with a Korean observer, to come together in an area where they shared one common concern—nuclear waste disposal. Clearly, the assembled representatives provided a striking reminder that the Cold War is indeed behind us—this type of intellectual exchange, interaction, and information sharing would have been difficult two years ago—unthinkable five years ago. This project was the first academically organized meeting in the United States to successfully promote

trilateral Japanese-Russian-United States exchange at the private sector, scientific, and governmental levels on this issue. Furthermore, the workshop marked the first time that delegates from the Russian Navy and the Russian Foreign Ministry attended a university-sponsored meeting, revealing important new data on the dumping issue. By all accounts, the interaction of our workshop participants was not only vital in providing a firm grasp of empirical reality, but also served as a necessary confidence-building step on the road to more concrete cooperation.

The two-day workshop utilized a round-table format which provided lively discussion and interaction among participants, and ensured frank exchange of diverse viewpoints and ideas. Morning and afternoon session were held each day. These sessions promoted intellectual exchange on the dumping issue in the areas of 1) physical setting, extent of nuclear contamination, and the results of recent surveys of some of the dump sites; 2) international cooperation; and 3) sharing of technical information. The preparatory committee was successful in building U.S. Congressional participation, and support with the help of Congressman Kurt Weldon of Pennsylvania and Senator Frank Murkowski of Alaska. In addition, many participants expressed their surprise at the apparent willingness of the Russian Navy representatives to disclose new information and discuss the situation with Japanese and U.S. participants. Workshop participants were briefed on potential financial support from international institutions for preventing nuclear waste dumping. This concept was explained in a paper by Mr. Koji Yamazaki, Deputy Chairman of the Board of Counselors, the Japan Research Institute, Limited.[1] During the closing session of the workshop, panelists commented on the overall positive information exchange that had taken place; however, all participants stressed the need for future meetings in order to promote long-term efforts to confront this serious issue of global concern.

RESULTS

This workshop produced unique discussion among participants drawn from academia, business, environmental organizations, and government. Yet, it became clear that more information is needed for officials and private citizens of Japan and the United States, along with Russia and Korea, to deal with disposal of nuclear waste, and to be in a position for assessing the level of environmental risk. According to data compiled at the January meeting, spent nuclear fuel seems to be a growing problem both on land and at sea. Workshop presentations indicated that little is known about the status of the dumped nuclear fuel in the three seas. However, no immediate risks have been identified. Another more potentially dangerous situation came to light. Russia is currently holding twenty years-worth of spent nuclear fuel waiting for proper disposal—a situation worsened by the collapse of the Russian defense industry. The danger still exists that Russia could dump more spent nuclear fuel and waste at sea. In order to fully understand the impact of this complex

[1]Unfortunately, Mr. Yamazaki was unable to attend the workshop; however, the text of his paper was distributed to workshop participants. Dr. Janos Radvanyi presented a brief summary on behalf of Mr. Yamazaki during Session Two, International Cooperation.

situation, the preparatory committee should continue this multi-national effort on a long-term basis, with special emphasis on confidence building and intellectual exchange.

RECOMMENDATIONS

During the closing session, workshop participants requested that the preparatory committee compile a list of recommendations based upon suggestions offered throughout the course of the workshop. Consequently, the preparatory committee recommends that a Multi-National Study Group be formed, consisting of representative from Japan, the United States, Korea, and Russia. This Study Group would hold a series of three workshops in order to:

1) attempt to obtain further information concerning dump sites in all three seas, gather information on short-term and long-term environmental consequences, and perform contamination risk assessments concerning local populations, marine ecosystems, and the overall global environment;

2) suggest ways and means for policy-makers to assist in alleviating Russia's current spent nuclear fuel storage crisis;

3) discuss the possibility of forming an expert group to visit Russian Pacific Fleet waste-storage facilities in Vladivostok, as well as U.S. facilities at Hanford, and similar storage sites in Japan;

4) facilitate quadrilateral technology and information sharing in order to alleviate the nuclear waste problem;

5) investigate potential financial support for preventing marine nuclear waste dumping, including the remediation of retired Russian nuclear submarines and other hazardous materials by inviting international financial institutions such as the International Monetary Fund, the Japan Overseas Economic Cooperation Fund, the Asian Development Fund, and the United States Export-Import Bank to these workshops;

6) concentrate on quadrilateral private-sector cost-and-time-effective plans for obtaining rapid and effective results in dealing with stabilization of threats at sea and on land in the Pacific area;

7) incorporate the experience and collaboration of GLOBE, an international parliamentary environmental organization, consisting of members of United States Congress, the Japanese Diet, the Korean Parliament, the Russian Duma, and other legislative bodies in order to develop ties not only with our Multi-National Study Group, but also to develop close bonds and trusting relationships with members of these respective parliaments and the scientific communities of all four nations;

8) improve understanding in the area of integration of existing knowledge concerning the dumping of radioactive wastes at sea in order to improve public awareness of this issue, as well as provide new data to interested scientists, corporations, government officials and organizations, NGO's and other environmentally oriented groups;

9) distribute summarized findings and reports to the public at large, as well as members of the scientific community, NGO's, government officials, and private sector representatives and libraries in all four nations; and,

10) create a quadrilateral data base on the environmental contamination and radioactive waste, possibly along the lines of the Arctic Data Directory developed through U.S.-Russian-Norwegian cooperative efforts. This data base would provide information gathered from Japan, the United States, Russia, and Korea to researchers, scientists, policy makers, and environmental groups via the Internet and BITNET.

Scientific Findings

Summarized from Papers and Presentations
Offered at the Biloxi Workshop
January 12-13, 1995

INTRODUCTION

Information gathered at the Biloxi workshop produced substantial amounts of timely and useful material. Russian scientists and representatives of the Russian Navy offered comprehensive and detailed pictures of the past activities of Soviet Naval dumping of nuclear wastes, and described the Russian Navy's practices of nuclear waste disposal. Not surprisingly, this presentation was disturbing, considering the unsophisticated methods of disposal utilized by the Soviets for the last twenty years. During the course of the workshop, Russian participants were quite forthcoming about the amount and character of radioactive waste disposed in the Sea of Japan, and went beyond the well-known Yablokov report by disclosing at least one additional dumping—the disposal of 0.38 curies of low-level waste in 1993. The Biloxi workshop produced twenty scientific papers, as well as a number of scientifically-based presentations and panel discussions. The comprehensive evaluation of the material by competent American agencies and scientists is still underway, and both Dr. Ruth Preller and Dr. Janice Boyd, both of the Naval Research Laboratory, Stennis Space Center, are revising their papers based on additional information revealed during workshop presentations.

DUMPED MATERIALS

Presentations made by the Russian Navy indicated that the amount of dumped liquid and solid low-level waste in the Sea of Japan is not significantly greater than the approximately 250,000 curies described by the Yablokov Commission Report. However, extensive details concerning the disposal of low-level waste in the Sea of Japan were presented by chemical experts of the Russian Navy. New data revealed in Captain 1st Rank V.M. Danilyan's report, "Nuclear Waste Disposal Practices in Russia's Pacific Ocean Region," is of significance. Contamination created by an accidental release of ^{60}Co in 1985 has been monitored in order to provide data concerning the transport of radionuclides in the Sea of Japan.

Some indication of the magnitude of radioactive waste disposal problem confronting the Russians was presented candidly at the conference. Not only did the Russian attendees identify the history of radioactive waste disposal activities carried out by the Navy of the Former Soviet Union (FSU), but from several sources there was a reasonably consistent identification of the storage and disposal requirements that result from the normal operation and from the decommissioning of nuclear submarines and surface ships. Annually, 20,000 m^3 of liquid radioactive waste and 6,000 tons of solid radioactive waste are generated from naval operations. While

the actual volume produced depends upon treatment technology used, nevertheless it is obvious that considerable quantities of waste, liquid and solid, must be handled.

However, it is important to note that data presented at the Biloxi workshop indicates that transportation pathways for materials released at dump sites are still unknown, but preliminary results suggest that the Sea of Japan upper level water mass circulation would probably transport suspended or dissolved materials in a south to southeasterly direction toward the northern Japanese islands.

The Korean report notes that current values of ^{137}Cs in the Sea of Japan are in the neighborhood of 3 mBq/kg at the surface. Reported data for the 1977-78 time show a higher concentration than would be supported by later measurements. With the exception of this point, this data is consistent with a model in which there is little removal of ^{137}Cs due to transport by currents. A separate report, compiled by several Russian participants, "Investigations of Marine Environment Radio-activity in the Dumping Areas and Coastal Zone of the Sea of Japan," confirms the values for ^{137}Cs noted in the Korean scientific report. Activities of ^{137}Cs ranged from 2.6 to 3.4 mBq/kg. These activities do not differ from background levels attributable to fallout from nuclear weapons testing, and are consistent with the data presented by Russian Navy representatives. In other words, if the assumption is made that low-level liquid radioactive waste originates from processing of spent nuclear fuel, then the radionuclides disposed at sea are the same as those that originate from atmospheric testing. Hence, it is not possible to determine the levels of radionuclide originating from marine disposal practices, since the inventory of nuclides such as ^{137}Cs from waste disposal is significantly less than the inventory from weapons testing. The ^{60}Co in Chazhma Bay furnishes the best indicator of dispersion, since ^{60}Co is not a fission product and therefore is not produced in explosions of nuclear weapons. Further, the half-life of ^{60}Co is 5.27 years, so measurable levels of activity correspond to events within the past two or three decades. Russian reports asserts that radioactive waste dumped in the Sea of Japan between 1974 and 1993 was dumped at station 9 (SNW 2,234), for which the depth is approximately 3,300 meters. A total of 10,840 curies were dumped in this twenty-year period. Kurchatov Institute scientist Dr. Serguei A. Bogatov claims that 10,600 curies were released in a single year around 1985. The composition of this is not known. However, additional data from the CREAMS [Circulation Research of East Asian Marginal Seas] research cruise of Summer, 1993 shows no special elevation of ^{137}Cs activity in surface waters at this sampling station. Several expeditions—one joint Japanese-Russian-Korean March-April 1994 cruise to the Sea of Japan sites, and the CREAMS 1993 joint Japanese-Russian-Korean expedition—support this data.

THE LAND-BASED HAZARDS

There is an immediate need to investigate the scale of the on-land storage problem in the Russian Far East, as well as to try to anticipate the potential for accidents involving mothballed or inoperative submarines and other sources of nuclear materials. Serious concerns were raised by several scientists about the extremely large quantity of nuclear waste remaining in the Russian Far East on-land temporary storage sites, and what manner of disposal would be used for this waste.

There was some dispute as to whether or not this waste may be a larger, long-term source of environmental problems and concerns than waste previously dumped at sea. Accidents involving decommissioned submarines, either during destruction or transport, were cited as principal concerns. Much of the high-level radioactive submarine waste of the Russian Pacific Submarine Fleet falls into this category, and this concern is one that needs additional, substantial investigation. The absence of carefully investigated, environmentally-sound, permanent disposal sites, further complicates this problem. Given the close proximity of the port of Vladivostok to Japan—less than 600 miles—any accident involving this waste could create a potential threat to human health. Therefore, further study of the radioactive waste problem must concentrate on land-based waste, along with ocean dumping, with regard to safe and scientifically proven disposal methods. Data furnished by workshop participants assisted in identifying the extent of Russian nuclear waste disposal.

CONCLUSION

The Biloxi workshop provided a forum for identification and description of Russian Navy nuclear waste disposal at sea since the beginning of the use of nuclear propulsion in the FSU. A complete record of disposal at sea was provided by Russian attendees. Their information was verified when measures and analyses presented at the workshop by American and Korean scientists were generally consistent with Russian reports of dumping. Problems, such as the hazards caused by stored radionuclides, were identified. Scientists, private sector participants, and representatives of NGOs, worked together to suggest solutions to the radioactive waste disposal and storage crisis in Russia. Private sector, scientifically based firms such as Mitsubishi International Corporation, Washington, D.C.; SAIC; Plasma Technology; and Neptune Science; are working with both dumped and land-based state-of-the-art radioactive waste disposal methods.

However, this workshop also established that more scientific work is needed, including more accurate identification of marine dumping sites. A clearer picture needs to be formed as to how spent liquid and solid nuclear waste will be disposed of in the future. It is not presently known how close the sampling locations were to the dumping sites. No Remote Operational Vehicle (ROV) studies or photographic examinations were conducted of the disposal sites. In order to supplement existing data, these studies are desirable. In addition, environmental risk assessments would be appropriate to determine the extent of the threat regarding the Sea of Japan, Sea of Okhotsk, and the North Pacific Ocean. Also, research about sub-lethal effects of radiation upon simpler life forms in the ocean could be a subject of investigation. Last but not least, workshop results indicate that more information gathering on the land-based waste situation is warranted.

Perspectives on Nuclear Dumping

Excerpts from Selected Papers
and Presentations
Offered at the Biloxi Workshop
January 12-13, 1995

RUSSIA

Dumping of liquid radioactive waste was carried out from 1959 to 1991 in five areas of the Northern Seas and 10 areas of the Far-Eastern Seas. Only one of these areas corresponds to London Convention's requirements. For the years between 1959 and 1991, dumping was very uneven. The annual mean values are about 300 curies per year for the Northern Sea and 320 curies per year for the Far-Eastern Sea. It should be noted that the similar value for the recovery plant in Sellafield, located on England's western coastline, that has been dumping liquid radioactive waste in the Irish Sea for the same time it is 66,000 curies of cesium-137 per year, obviously much more.

As a rule, solid radioactive waste of low and intermediate level activity was inclosed in metal containers with steel walls is 0.3-0.4 ml thick. Large scale radioactive waste was flooded separately in Ural side special ships. The main annual activities of the solid radioactive waste were about 500 curies per year for the Northern Sea and 250 curies per year for the Far-Eastern Seas. However, the activity of solid radioactive waste recorded in the White Paper [identified above] is presented in terms of equivalent of strontium-90. Since the part of the strontium-90 activity in the usual solid radioactive waste of light water reactive is about 5%, conventional activities presented above should be multiplied by factor 20. Therefore, annual solid radioactive waste dumping is approximately 10 kg curies per year for the Northern Sea and 5 kg curies per year for the Far-Eastern Sea. These dumpings are much smaller than permissible ones—about 1 meg curies per year. However, the objects containing reactor spent fuel that was dumped in the Kara Sea are considered to be the most dangerous. It is noted in the White Paper that one submarine with two loaded reactors, a reactor compartment containing two reactors with the fuel, a reactor compartment containing one load and one unloaded reactor, and one submarine reactor containing nuclear fuel are flooded in the base of Novaya Zemlya. Besides the steam-producing installation okey-150 of the Icebreaker Lenin was flooded there as well. Okey-150 contains 125 assembles with radiated nuclear fuel. Reactor unloading was impossible in all cases due to accidental active zone conditions. In some cases the reactor compartment without fuel, but having high inventory of activation product nickel-59, 63 and cobalt-60 were dumped also.[2]

Stemming from the principles and recommendations developed in the FSU by MAGATE 10 regions in the Sea of Japan, the Sea of Okhotsk, and near the southeastern cost of Kamchatka were selected as dump sites for nuclear waste. The

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[2]Dr. S.A. Bogatov, the Kurchatov Institute, Moscow, *"Presentation."*

data shows that the regions one and two in the Sea of Japan, region 3 in Sea of Okhotsk and region 4 near Kamchatka were not used for waste disposal. For the past 30 years nuclear waste disposal took place only in the regions 6, 9, and 10 in the Sea of Japan, and region 8 near Kamchatka peninsula. The maximum multi-year load of these regions did not exceed 7% of the permissible limits for liquid waste disposal (region 9 in the Sea of Japan) and 5% for solid waste (region 8 near Kamchatka peninsula). The total radioactivity of low and medium radioactive nuclear waste disposed by the FSU Navy in the Pacific Ocean comprises 6,979 curies. This radiation is contained in 6,868 flooded containers, 38 ships and more than 100 separately large objects. The amount of the liquid waste is 12,298 curies. The total sum of all waste dumped into the Pacific ocean is 19,265 curies. It should be mentioned that while selecting nuclear waste dumping regions, that 9 out of 10 regions do not meet the MAGATE and London Convention requirements in depths, internal seas, latitudes, except for region 4 near Kamchatka peninsula.

Radio-ecological studies performed every 3 to 5 years by Pacific Ocean Fleet Chemical and Medical Services specialists, in collaboration with colleagues from the Navy Central Medical Laboratory and the State Hydrometeorological Committee, showed that the concentration of major artificial radionuclides in the seas' waters does not exceed background values. A joint Japanese-Korean-Russian expedition to the Russian regions of nuclear waste disposal in the Sea of Japan has also arrived at similar conclusions. Long-term radio-ecological observation has shown that the low active waste disposal from special laundries and shower-baths at atomic fleet maintenance stations does not lead to environmental radioactive pollution which exceed permissible levels. The concentration of artificial radio-nuclei in adjacent regions does not exceed background values.[3]

Results of several recent expeditions, which were carried out in Lafier in 1993 in the Sea of Japan. The first was performed in March and April of last year, and was the first Japanese-Korean-Russian joint expedition to study the radioactive waste dumping areas. About 40 specialists from Japan, Russia, Korea, and IAEA participated in this expedition. A separate Russian expedition, carried out in September and October of 1994, took place in Peter the Great Bay and Bolshoi Kamen Bay, which is the area the Navy uses to reprocess or utilize nuclear submarine is situated, and in Chazhma Bay. Chazhma Bay is the area [mentioned by Captain Danilyan earlier] where a nuclear submarine accident took place in 1985. A third expedition pertinent to this topic is the joint Japanese-Korean and Russian project known as Circulation Research of the East-Asian Marginal Seas (CREAMS) that deals primarily with the Sea of Japan. The following results of these cruises are limited to findings in the Sea of Japan. These are preliminary results, but now these results of the detailed measurements already available [in Russian text and in the near future these results should be exchanged with our Korean and Japanese colleagues, and then after joint evaluation of these results, the final report should be prepared].

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[3]Captain 1st Rank V. Danilyan, Russian Navy,*"Practice of Nuclear Waste Treatment in the Russian Pacific Fleet."*

The cesium-137 results for the surface seawater—of subsurface measurements, not direct are at the background level typical for the North Pacific, explained mainly by fall out of the radionuclides from the atmosphere. For the bottom seawater, cesium-137 figures are also very low and for bottom sediments the figures were below the detection limit of spectrometric devices, which were aboard the ship. Because there is a very limited data on deep water current in the Sea of Japan, the CREAMS expeditions, the main goal of the Korean scientists was to study the circulation of the Sea of Japan. And during the summer cruise of 1993 three murine had been deployed within the study area and one of these murine was situated just close to the dumping areas, there are some coordinates and water depths 3,500 meters and current meter devices, current meters were established at 1,000 meters depths, 2,000 and 3,000 meters depths. The following results of these measurements, for approximately September of 1993 to May–June of 1994, reveal that at 2,000 meter depth current speeds may be up to 20 sm/sec, during some periods in winter. At 3,000 meter depth, current speeds may be as high as 10 sm/sec. So in the case of any leakage of radionuclides from dumped containers, these radionuclides can be transported throughout the entire Sea of Japan. The direction of these currents changes through the year, so consequently, radionuclides can be transported in all directions.

As for Peter the Great Bay, preliminary results of direct or unsettled measurements by spectrometric devices of Russian Navy found that the figures for levels of cesium-137 were just below the detection limit. Samples of the seawater and bottom sediments are stored in the laboratory for future analysis, and therefore, these figures can be improved in the near future. Figures for the surface bottom sediments were somewhat more accurate than that for seawater, ranging from 1.5 up to 11 bq/kg and in subsurface it was below 5 sm in the bottom sediment, approximately the same range. These figures are not above the background level, and are just comparable with the background level, or in some cases qualify as non-contaminated sites in the Sea of Japan. At one site near Bolshoi Kamen Bay, the levels were higher due to the shipyard. According to Captain Danilyan's report, the radionuclides from Chazhma Bay were transported gradually to the open sea. Nevertheless, this activity is below the Russian permissible level of radioactivity of bottom sediments. Cesium-137 activities just to the south from the middle of Chazhma Bay, for example, and Cesium-137 levels to the south from the middle of this Bay, were below detection limit, so below 1.5 bq/kg, the same situation for Cobalt-60, only in this local area near Chazhma Bay and at one point in the Usuriysky Bay, as the results of the full load after this nuclear accident here, the expedition found elevated activities of Cobalt-60. At all stations, the activities of Cobalt-60 in bottom sediments were below 2 bq/kg, below the detection limit of the spectrometric devises used.[4]

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[4]Dr. A. V. Tkalin, Far Eastern Regional Hydrometerological Institute, Vladivostok, "*Investigation of Marine Environment Radioactivity in the Dumping Areas and Coastal Zone of the Sea of Japan.*"

THE UNITED STATES

The concentrations of radioactive anthropogenic contaminants in the near-Alaskan marine environment are relative low and an order of magnitude lower than activities concurrently measured in more polluted ecosystems (e.g. the Black Sea and Kara Sea). Nevertheless, there is evidence for contaminants in the near-Alaskan marine environment potentially originating from North Atlantic (Sellafield) and former Soviet Union sources. These indications include subsurface maxima in Laptev, Beaufort, and Chukchi Sea iodine-129 concentrations, elevated cesium-137 concentrations in Arctic Ocean sea ice, and plutonium 240/239 ratios in deep Canada basin and Laptev Sea sediments that are consistent with fuel reprocessing sources. Nevertheless, the trace level of these contaminants, and the complex suite of physical and biological factors affecting sediment and water column radionuclide concentrations in near-Alaskan waters will provide a challenge for any monitoring program attempting to unequivocally detect Arctic radionuclide contamination in Alaskan waters that originates from sources in the former Soviet Union.

Although a catastrophic release of contaminants through river flooding or open breaching of containers is one potential outcome of Arctic nuclear waste disposal, it is also possible that subtle detection of newly introduced contaminants will be the only result of a long-term monitoring effort. In order for such monitoring to have the largest chance of significant findings, it should include elements that include detecting seasonal and annual fluctuations in radionuclides that may be linked to transport in ice, or water circulation patters. Location of the sampling devices at strategic points affected by seasonal ice cover, or in important straits (e.g. Bering Strait) will also be important, at least for monitoring in near-Alaskan Waters. Although there has been increasing concern over Arctic radioactive contamination, these relatively low inventories do not, by themselves, provide direct evidence for major contamination of the Bering and Chukchi Seas. Cross-Arctic profiles of ^{129}I, detection of low $^{240}Pu/^{239}Pu$ ratios in deep Arctic sediments, and detection of higher levels of ^{137}Cs in sea ice indicate potential contributions from nuclear fuel re-processing and waste disposal, possibly in some cases from former Soviet Union sources, or even more distant locations such as Sellafield on the Irish Sea. Despite these indication of the need for monitoring in the Arctic marine environment, it is likely to remail difficult to unequivocally demonstrate nuclear contamination in waters of the U.S.A. Exclusive Economic Zone resulting from activities of the former Soviet Union.

Comparison over the past five years suggest that ^{137}Cs concentrations in Alaskan marine sediments are continuing to decline, which is consistent with the hypothesis that almost all radiocesium present in the marine ecosystem of the Bering and Chukchi Seas originated from nuclear weapons testing in the 1960s, and that no new significant sources are being contributed. Spatial variability in the ^{137}Cs distributions appears to be dominated by bothurbation in areas of high biological

activity, particle settling and current patterns, and locally by the presence of freshwater inflows.[5]

As for the situation in the Pacific, after the international protests against the last dumping of liquid radioactive waste (LRW) at sea in the Sea of Japan in October 1993 from the *TNT-27* [tanker ship], the Russian government forbade the Pacific Fleet from dumping more LRW at sea. This left the fleet with a considerable amount of LRW aboard various vessels, which needed processing. Of particular concern was the situation aboard the *TNT-5*, which was leaking and in danger of sinking at dockside with several hundred tons of LRW in its holds. In 1994, the Navy shipped two small-scale portable, trial LRW processing units to the Pacific Fleet. Reportedly, known as a SHARYA-04, a unit is operated by 10-12 people, has a capacity of 0.5 cubic meters per hour, and can reduce 900 tots of the LRW aboard all *TNTs* to 5-9 tons of dense salt solution. In 1994, the first SHARYA-04 went to the Shkotovo area, and a second was sent to Kamchatka, reportedly in September. In 1994, some LRW was processed on the *TNT-5* utilizing this facility, but its is unclear how much was done before winter conditions forestalled further operations.

Plans drawn up in the 1980s and 1990s by the Navy and the government for an orderly solution for dealing with decommissioned nuclear-powered submarines were never implemented. As a result, the large number of nuclear powered submarines being removed from service in the 1990s has compounded the existing nuclear waste disposal problem. As of 1992, there were 35 decommissioned nuclear submarines in the Pacific Fleet. By late 1994, the number had grown to 53 according to a Russian State Duma report. Another 10 or so submarines may be decommissioned by the end of the decade. Decommissioned submarines are found at the nuclear submarine shipyards in the Primorskii Kray (Bolshoi Kamen and Chazhma Bay) and in Kamchatka (at Gornyak near Rybanchiy) and at the nuclear submarine bases at Pavlovsk (near Vladivostok), Rakushka (on Vladimir Bay near Olga), Zavety Ilyicha (near Soveskaya Gavan), and at Rybanchiy (near Petropavlovsk). Approximately only a third of the submarines have had their spent fuel off loaded due to the lack of service ships and because the spent fuel storage buildings are nearly full. Lack of capacity in the spent storage buildings is in turn due to the absence of spent fuel shipments to Chelyabinsk. Spent fuel shipments to Chelyabinsk are not occurring because of lack of money to pay Mayak and also because the new TUK-18 spent fuel casks are too heavy for the existing road and rail system. As a result, many submarines in poor condition are tied up in the submarine bases and shipyards with their spent fuel still on board.

Of the submarines which have had their fuel off loaded, by spring 1994 only five to six had been scrapped at the Zevzda plant at Bolshoi Kamen. In the scrapping process, reactor compartments and two adjoining compartments are cut out of the submarine, sealed up, and then, because there is no land-based storage site, stored afloat in Razboinik Bay across from the Chazhma bay shipyard. Four other entire,

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[5]Dr. Lee W. Cooper, Jacqueline M. Grebmeir, and I.L. Larson, portions taken from *"What does Near-Alaska Radionuclide Data Indicate about Future Monitoring Strategies?"*

defueled, decommissioned submarines have been prepared for long-term storage afloat by the Chazhma Bay and Gornyak shipyards. Since the Zevzda plant's capacity for scrapping is so low (1-2 hulls a year), to speed the process, from 1986, the Navy plans just to cut out the single reactor compartment and start burying the reactor compartment in a special repository. Throughout 1992, what little decommissioning work being done in the Pacific Fleet was being financed out of the Pacific Fleet Technical Directorate's funds, using money otherwise earmarked for ship maintenance. After 1992, the Navy apparently allocated from its budget extra monies for decommissioning, but only 15% of the planned sum for the Pacific Fleet was received. The lack of funding for maintenance is shortening the service life of submarines, further increasing the numbers being retired. A recent Duma report on the situation in the Pacific Fleet worried that if for the next five year the Navy's funding was kept at the 1993 level, the currently operating nuclear-powered ballistic missile submarines in the Pacific Fleet would become non-operational due to the lack of support.

Due to secrecy, this shore-side naval waste problem has been poorly understood, particularly in the case of the Pacific Fleet. The size of the problem, however, is considerable. Substantial amounts of radioactive waste have been collected at the bases and storage sites of the Pacific Fleet. Burial trenches in waste sites are leaking radiation into the surrounding ground. Aging nuclear submarine service ships in poor condition are in danger of sinking at dockside with their nuclear cargos of radioactive waste aboard. Naval officers worry that decrepit decommissioned nuclear submarines tied up at submarine shipyards and naval bases with their nuclear fuel still aboard could also sink even as more nuclear submarines join the decommissioning queue. Any attempts to deal with the radioactive waste crisis in the region must take these factors into account.[6]

KOREA

Dr. Gi Hoon Hong has been involved in various meetings, both as a technical advisor to the Korean Government, and as a research scientist investigating the consequences of radioactive waste disposed of in the East Sea (Sea of Japan) by the FSU and the Russian Federation. This research has been carried out in domestically organized expeditions and the Korea-Japan-Russia trilateral joint expedition in 1994. A second joint expedition is planned for the Sea of Okhotsk and the North Pacific Ocean, and another cruise to Japanese and Korean low-level radioactive waste dumping areas in 1995. Marine science oriented programs of academic research will complement the official governmental level of fact-finding missions. Therefore, Hong is very pleased to see the concrete development of international cooperation to tackle the important environmental and political issues of nuclear waste dumping in the Russian Far Eastern seas.

There are a few ongoing regional oceanographic programs in the Sea of Japan where the most radioactive waste was dumped, such as CREAMS among Korean, Japanese,

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[6]Mr. Joshua Handler, "*The Radioactive Waste Crisis in the Pacific Area.*"

and Russian scientists as well as other bilateral programs among the countries sharing the Sea of Japan. Those programs are tied or provide essential information for assessment of the environmental consequences of the dumped radioactive waste in the seas, including contaminant dispersal modeling, comparative baseline radioactivity data, radiological assessments, and radionuclide cycling pathways.

Findings are fairly consistent with the data presented thus far. For example, during a Korean cruise in the summer of 1993, water samples were taken in order to analyze cesium-137 activities including the areas of nuclear waste dumping. The resulting figures range from 2.58 - 3.35 mbq/kg seawater (see Russia, Dr. A.V. Tkalin, for further information).[7]

[7]Dr. G. H. Hong, *"Korean Observer's Remarks."*

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[8]Please note that the full text of workshop transcripts will be available in 1996. However, the CISS does have the written texts and overhead copies indicated in the bibliography available for distribution.

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[9]Dr. Preller is extending her paper using scientific data from the Biloxi workshop as source material.